UNITED STATES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LANGLEY RESEARCH CENTER

HAMPTON, VIRGINIA

SPECIFICATIONS

FOR

14 X 22 FOOT SUBSONIC TUNNEL FAN BLADES

BUILDING 1212C

LOCATED IN

WEST AREA

LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA

SPECIFICATION NO. 1-LBK-4200045201 DATE: 1-12-04

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under these specifications consists of the fabrication and delivery of ten (10) wooden fan blades for the 14 x 22 Foot Subsonic Wind Tunnel, Building 1212C, 17 West Taylor Street, West Area, of the Langley Research Center.

Base

Fabrication, inspection and delivery of initial blade No. 10.

Option 1

Fabrication, inspection and delivery of fan blades No. 11, 12, and 13.

Option 2

Fabrication, inspection and delivery of fan blades No. 14, 15, and 16.

Option 3

Fabrication, inspection and delivery of fan blades No. 17, 18, and 19.

The Contractor shall furnish all plant, equipment, tools, materials, labor and services necessary for or incidental to a complete and finished job as shown on the drawings listed and as specified.

The Government reserves the right to witness and inspect the fabrication process at the Contractor's plant at any time.

All references to the Contracting Officer contained in this specification, or any severable part thereof, shall be determined to mean the Contracting Officer or the Contracting Officer's Technical Representative. If any question arises concerning the "authorization" status of a Contracting Officer Technical Representative, the Contractor shall immediately refer the question, in writing, to the Contracting Officer. Any references to "as directed", "approved by", "witnessed by", or "submitted to", shall be determined to mean the Contracting Officer.

Where "as indicated" and "as specified" are written it shall refer to "as indicated on the drawings," and "as specified in the specifications". The specifications will always take precedence over the drawings.

Where "day" or "days" are written it shall mean calendar day or days, unless otherwise stated in the specification.

Where "hour" or "hours" are written it shall mean clock hours, unless otherwise stated in the specification.

1.2 DESCRIPTION

The ten fan blades shall be fiberglass-covered, laminated Sitka Spruce.

1.3 STORAGE AND SHIPPING CRATES, SHIPPING AND INSURANCE

1.3.1 Storage and Shipping Crates

Prior to delivery, each blade shall be individually wrapped and sealed in polyethylene film .010-inch thick. The sealed package shall contain a desiccant for moisture protection.

A crate shall be fabricated for each blade designed to protect the blade from damage during shipment and/or storage. Each blade shall be properly secured in its individual crate to prevent movement during shipping and handling.

Each crate shall be constructed using a minimum of 3/4-inch thick plywood, Grade AC minimum, exterior panels. Support pads shall be attached to the bottom of each crate to facilitate lifting and moving using a standard industry forklift. Crates shall support stacking to a maximum of three (3) crates high.

Each crate shall be constructed with a removable top to allow visual inspection of the entire blade without dismantling the crate.

Each crate shall be painted with two (2) coats exterior-grade white paint and marked in three (3) locations with three (3) inch high lettering on the top (removable panel), front and one end with the following information:

U.S. Government Property
NASA LaRC 14 x 22 Ft. Subsonic Tunnel
Fan Blade # (blade number)

Caution: Do Not Store Containers Outside

Caution: Do Not Stack Containers More Than 3 High

1.3.2 Shipment

Shipping crates with blades shall not be exposed to outside elements during shipping or at any time.

1.3.3 Insurance

The Contractor shall provide freight insurance on each shipment of completed blades. Insurance on each shipment shall be sufficient to cover replacement of each blade should it become damaged or destroyed during transit from the Contractor to NASA Langley Research Center.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, Submittals:

SD-08 Records

Results of modal and dimensional surveys of Initial Blade
Results of modal and dimensional surveys of Remaining Nine Blades

Deliverables:

Test report containing the following:

Description of the test configuration
Description of the test instrumentation
Summary of the tests performed
Summary of the test data
Summary of the analysis methods and results

Data Products

The following data products shall be delivered:

Test data (frequency response functions, coherence functions, and autospectra) provided in SDRC I-DAES Universal File Format (U58)

Summary of the identified structural modes (frequencies, damping, and mode shapes)

Mode shapes for all identified modes in SDRC I-DEAS Universal File Format (U55)

Sensor locations and identifications in SDRC I-DEAS Universal File Format (U15)

1.5 DRAWINGS

After contract award, a maximum of five sets of full D-size and five sets of 1/2 size contract drawings will be furnished to the Contractor without charge.

1.5.1 Contract Drawings

The work shall conform to these specifications and the drawings listed below:

DRAWING NO.	REV.	TITLE	LATEST DATE
LD-514649	D	Blade Detail	11-21-03
LD-514650	D	Coordinate Tables - Blade Sections	7-15-97
LD-514651	D	Butt Detail	11-21-03

The Government will final fit and install the blades, reference Note 3 on

Contract Drawing LD-514649. The Government will drill the holes referenced in Note 1 and Note 2 on Contract Drawing LD-514651.

1.5.2 Reference Drawings

The following drawings are provided for information only, to assist the Contractor in performance of the requirements of these specifications:

DRAWING NO.	REV.	TITLE	LATEST DATE
LD-514648	A	Assembly	7-15-97
LD-514656	-	Mounting Box-Blade	10-12-67

1.6 SCHEDULE

1.6.1 General Schedule Requirements

All work as required by these specifications shall be completed within 365 consecutive calendar days after receipt of Notice to Proceed.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01011

GENERAL AND ADMINISTRATIVE REQUIREMENTS

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SECTION 01011

GENERAL AND ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers Langley Research Center's unique general and administrative requirements.

1.2 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals:

SD-08 Statements

Materials and Equipment Substitutions

SD-18 Records

Order Status Reports

Schedule of Production

Monthly Progress Reports

Contractor Release Form

1.3 ADDRESSING CORRESPONDENCE, SUBMITTALS AND INVOICES

All correspondence, submittals and invoices shall be clearly marked with the assigned Government contract number. Unless otherwise specified herein, the Contractor shall submit an original and five copies of all correspondence and submittals.

The Contractor shall submit all shop drawings, test reports, equipment data sheets, and any other technical data under an original cover letter and with copies as required by these specifications. Samples shall be accompanied by a cover letter and appropriate copies.

Correspondence and submittals shall be addressed to the designated Government addressee(s) and mail stop(s) shown in the Submittal Summary of Section 01330 to the following address:

All correspondence to the Contracting Officer or Contract Administrator shall be addressed as follows:

Contracting Officer/Contract Administrator, Mail Stop 126

Contract NNL- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

All correspondence to the Contracting Officer Technical Representative (COTR) shall be addressed as follows:

COTR, Mail Stop 465
Contract NNL- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Invoices and Contractor's release form (NASA Form 778) shall be addressed as follows:

Accounts Payable and Employee Services Branch, Mail Stop 175
Contract NNL- _____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Submittals to the Safety and Facility Assurance Office shall be addressed as follows:

Safety and Facility Assurance Office, Mail Stop 429
Contract NNL-_____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

Submittals to the Environmental Management Office shall be addressed as follows:

Environmental Management Office, Mail Stop 418
Contract NNL-_____
NASA, Langley Research Center
Hampton, Virginia 23681-0001

1.4 SCHEDULE OF PRODUCTION, MONTHLY PROGRESS SCHEDULES AND MONTHLY TECHNICAL PROGRESS NARRATIVES

1.4.1 Schedule of Production

With the proposal, the Contractor shall submit electronically to the Contracting Officer for approval, a practical and feasible schedule of production using Microsoft Project. This schedule shall indicate the sequence of work the Contractor plans to complete the contract within the specified completion period and shall include, as a minimum, the following categories of work:

- Receipt of materials
- Bonding of initial blade
- Machining of initial blade
- Inspection and testing of initial blade
- Bonding of remaining 9 blades
- Machining of remaining 9 blades

- Inspection of remaining 9 blades
- Shipping/Delivery

The schedule shall show initial blade work first. Upon Contracting Officer approval of the schedule of production, the Contractor shall utilize this approved schedule for its contract progress schedule reporting. The Contractor shall adhere to the approved schedule of production. The schedule of production shall not be altered without the written approval of the Contracting Officer. In the event of changes in the schedule of production, under applicable provisions of the contract, the Contractor shall resubmit to the Contracting Officer, the schedule of production reflecting such changes.

Questions, concerns, and information pertaining to the project shall be submitted to the Contracting Officer on Form 253, Request for Information, Attachment 1 to this section.

1.4.2 Monthly Progress Schedules

The Contractor shall prepare monthly progress schedules, on Form LF-107, in accordance with the instructions on the reverse side of the form and shall show both the NASA approved schedule and the Contractor's current working schedule.

1.5 CONTRACTOR RELEASE FORM

The Contractor shall execute and submit a Contractor Release Form, NASA Form 778, at contract completion.

1.6 ORDER STATUS REPORTS

Upon request of the Contracting Officer, the Contractor shall promptly submit reports showing the status of any orders or subcontracts which may delay or are delaying the overall contract schedule. Order status reports shall include:

Contract or order number, date submitted to the supplier, date accepted by the supplier, supplier's name and address.

Delivery date needed to meet contract schedule.

Delivery date agreed to by the supplier, and any subsequent changes in that date.

Reasons for changes in delivery dates.

Effect which the latest promised delivery date will have on the contract schedule.

A summary of the Contractor's efforts to bring the promised delivery date in line with the requirements of the contract schedule, including efforts made to place the order or subcontract with other suppliers.

1.7 MATERIALS AND EQUIPMENT

Materials and equipment provided by the Contractor shall be standard catalog products of manufacturers regularly engaged in the manufacture of the products unless otherwise specified.

Materials and equipment shall meet the requirements of the contract and shall be suitable for the specified installation. Where two or more units of the same equipment class are furnished, the equipment shall be from the same manufacturer and shall be interchangeable. Materials and equipment shall be new and free from defects.

Where equipment specified by designations of the manufacturer requires modification to fully meet contract requirements, such modification shall be made by the Contractor without additional cost to the Government.

Where two or more types of equipment or materials are specified without indication of preference, it shall be optional with the Contractor which one is used; but the same type shall be used throughout.

Where equipment or materials are specified by the designations of the manufacturer, "or equal", the Contractor, if it elects to furnish other than the brand name product, is responsible for any necessary redesign, relocation and rework of associated construction, at any time during the course of the contract. The proposed materials or equipment substitution with any required redesign, relocation, or rework data shall be submitted for approval of the Contracting Officer.

All equipment and material data, including location, function, and characteristics shall be furnished to the Contracting Officer for approval as specified in Section 15051, "Mechanical Requirements". Machinery, equipment, materials, and articles furnished without such approval shall be at the risk of subsequent rejection.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

Request for Information (R.F.I.)

Distribution:

TO:

FROM:

Contract No.:	Project/Delivery Order (DO) Number:	Project Title:

TO BE COMPLETED BY REQUESTOR

RFI No.:	Date Submitted:	Title:

REPLY BELOW

REVIEWER:	M/S:	DATE TO REVIEWER:	DATE FROM REVIEWER:

REVIEWER: *(printed name)*	SIGNATURE:	Date:
COTR: *(printed name)*	SIGNATURE:	Date to Requester

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01330

SUBMITTALS

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SECTION 01330

SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

This section defines and explains the general submittal requirements applicable to all submittals under this contract. Specific submittals required are set forth by the various administrative or technical sections of this specification, the contract drawings, or other portions of this contract. Accordingly, the Contractor shall make timely and complete submittals as required by all applicable contract provisions.

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTAL PREPARATION AND CONTENT

1.2.1 Technical Submittals

All technical submittals, for action of the Contracting Officer, shall be submitted on the Langley Technical Submittal Form (see Attachment 1). The actual transmittal form for this project will be transmitted to the Contractor at the time of Notice to Proceed.

The technical submittal form shall serve as the Contractor's cover sheet and also the Government's approval/review sheet back to the Contractor.

The Contractor shall submit one technical submittal form cover sheet for each package of submittals.

Technical submittals shall be grouped by specification section, limited to eight (8) submittals per cover sheet from one specific specification section.

The Contractor shall complete the item number, specification section and paragraph number, SD number and description for each item submitted.

The Contractor shall note any specification deviation included in the submittal package.

1.2.2 General

All submittals shall be in the English language.

Submittals become the property of the Government. The Government reserves the right to duplicate, use, and disclose, in any manner and for any purpose, shop drawings delivered under this contract. Wording such as

"Confidential", "Do not reproduce", and similar statements shall not be included on the submittals. Submittals that prohibit duplication will be returned to the Contractor for correction and resubmitting. Refer to FAR 52.236-1, Performance of Work by the Contractor, for additional information.

The Contractor shall specifically point out variations of submittal items from contract requirements in transmittal letters. Failure to point out deviations may result in the Contracting Officer requiring rejection and removal of such work at no additional cost to the Government.

The Contractor shall allow 30 calendar days for review of submittals. If the Contractor deems a submittal critical or urgent (e.g., to order long lead-time items; enter into firm subcontracts or supplier purchase orders), it shall so state on the letter or form transmitting such submittal and shall indicate its priority for the items submitted.

The Contracting Officer will, after receipt of submittals, return one copy to the Contractor marked "Reviewed", "Approved," "Approved with corrections as noted," "Reviewed with corrections as noted," or "Returned for corrections," which shall be interpreted as follows:

Submittals marked "Reviewed" authorize the Contractor to proceed with the work covered by such submittals.

Submittals marked "Approved" authorize the Contractor to proceed with the work covered by such submittals.

Submittals marked "Approved with corrections as noted" or "Reviewed with corrections as noted," authorize the Contractor to proceed with the work covered by such submittals in accordance with the corrections indicated thereon. The Contractor shall make the corrections to the submittals and resubmit them to the Contracting Officer within fifteen calendar days after receipt of the marked submittals.

Submittals marked "Returned for correction" require the Contractor to make the necessary corrections and revisions to the submittals and to resubmit them for approval by the Contracting Officer.

Where the submittal is for Information, the Government may indicate recommended corrections, or take no action, at its discretion. The Contractor may proceed with the work without response from the Government.

Government review or approval does not relieve the Contractor of responsibility for the accuracy and correctness of submittal data furnished or for compliance of the submittal's subject items with all applicable contract requirements.

Where review of the submittals is indicated, the Contracting Officer will notify the Contractor of any recommended corrections within 30 calendar days after receipt. If the Government takes no action within 30 calendar days, the Contractor may assume Government acceptance and proceed with the work.

Where Approval of submittals concerning materials, drawings, or other

submittals is required prior to work execution, the Contractor shall not proceed with the affected work until such approval is received from the Contracting Officer. Government action will be taken within 30 calendar days.

Partial Submittals will be accepted for expediency of the contract's completion.

1.2.3 Calculations, Drawings, Data, and Other Contractor Submittals

The Contractor shall collect the required data submittals for each specific material, product, unit of work, or system into a single submittal and mark for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical.

1.2.4 Submittal Descriptions (SD)

Submittal Description (SD): These are drawings, diagrams, layouts, schematics, catalog cuts, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific equipment and portions of the contractually required work.

The following items are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification section.

SD-01 Data

General:

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-07 Schedules

Tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-08 Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other subcontractor, to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications, or other verification of quality. This shall include plans or other documentation to ensure compliance with local, state, and federal safety laws and regulations.

SD-09 Reports

General:

Reports of inspections and/or laboratory tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Test Reports:

A report signed by an authorized official of a testing laboratory that a material, product, or system identical to the material, product, or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory Test Report:

A written report which includes the findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for this project before it is shipped to the job site. The report must be signed by an authorized official of the manufacturer or an independent testing laboratory and must state the test results. The report shall also indicate whether the material, product, or system has passed or failed the test. These reports shall be subject to approval of the Contracting Officer, unless otherwise specified herein, before delivery of the materials or equipment. This approval shall not relieve the Contractor of the obligation to meet all the requirements of the contract.

Field Test Report:

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. The report shall be signed by an authorized official of a testing laboratory or agency, must state the test results, and indicate whether the material, product, or system has passed or failed the test.

SD-13 Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meets specified requirements. The statements must be dated after award of contract, name the project, and list the specific requirements.

SD-18 Records

Documentation required for contract administration.

1.3 MARKING

Marking shall be provided for each submittal to identify it by contract

number, transmittal date, Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s), submittal name, specification section and paragraph reference, drawing reference, and similar information to distinguish it from other submittals and to identify its contractual requirement source(s).

1.4 SUBMITTAL REQUIREMENTS

The following submittal summary chart itemizes the general and specific submittal requirements under this contract. The following letter codes designate the Government addressee(s) and Mail Stop(s):

A - Contract Administrator, Mail Stop 126

B - Contracting Officer Technical Representative, (COTR), Mail Stop 465

C - Safety and Facility Assurance Office, Mail Stop 429

D - Construction Services Unit, Mail Stop 428

E - Accounts Payable and Employee Services Branch, Mail Stop 175

F - Environmental Management Office, Mail Stop 418

The number following the letter code, as shown in the submittal summary chart, specifies the number of copies to be provided, (e.g., B-6). The required number of all submittals shall be delivered prepaid to Langley Research Center, Hampton, Virginia 23681-0001 addressed to the appropriate recipient and Mail Stop number as shown above.

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
SD-01, Data					
Photographic Documentation	With Monthly Report	---	B-6	Information	15051
SD-07, Schedules					
Moisture Meter Calibration Documentation	Before Field Use	---	B-6	Approval	15051
SD-08, Statements					
Quality Assurance Plan	With Proposal	---	B-6	Approval	15051
Lumber Drying Facility	With Proposal	---	B-6	Approval	15051
Lumber Inspector Qualifications/ Certifications	With Proposal	---	B-6	Approval	15051
Modal Survey Inspector Qualifications/ Certifications	With Proposal	---	B-6	Approval	15051
Material and Equipment Substitutions	Before Fabrication	---	B-6	Approval	01011
Project Implementation Plan	With Proposal	---	B-6	Approval	15051
SD-09, Reports					
Modal Survey Results for Initial Blade	Prior to Phase 2	---	---	Approval	15051
Modal Survey Results for Other 9 Blades	At Delivery	---	---	Information	15051

SUBMITTAL SUMMARY

TITLE	FIRST SUBMITTAL	UPDATE	LTR CODE AND DISTRIBUTION	GOVERNMENT ACTION	SECTION
SD-13, Certificates					
Lumber Certification	Before Fabrication	---	B-6	Approval	15051
Polyester Resin	With Proposal	---	B-6	Approval	15051
Resorcinol Glue	Prior to Fabrication	---	B-6	Approval	15051
Fiberglass Cloth	Prior to Fabrication	---	B-6	Approval	15051
Birch Plywood	Prior to Fabrication	---	B-6	Approval	15051
SD-18, Records					
Order Status Reports	**	---	B-3	Information	01011
Schedule of Production	With Proposal	---	A-1, B-5	Approval	01011
Monthly Progress Schedules	15th Day 30th Day of Each Month		A-1, B-5	Review	01011
Contractor Release Form	At Contract Completion	---	E-1	Review	01011

NOTE: Submittal Summary requirements are listed in Calendar Days.

* Calendar days after date of receipt of Notice to Proceed
** As required by specifying section with updates when significant changes occur

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

Technical Submittal Form

Date Received:

TO:

FROM:

Distribution:

Contract No.:

Title:

TO BE COMPLETED BY CONTRACTOR

Submittal ☐ New ☐ Previous

Submittal Number:

Previous Submittal Number:

Item #	Specification Section Para No./Dwg. No.	SD No.	Description of Material (Include Type, Model No., Catalog No., Mfg., Etc.)	Action Code	Initials

Contractor Representative:

Signature:

Date:

Government Action Codes: A-Approved; AC-Approved with corrections as noted; RE-Reviewed
R-Returned for corrections; RC-Reviewed with corrections as noted;

FOR GOVERNMENT USE ONLY

To Reviewer:	M/S:	To Reviewer: Date:	From Reviewer: Date:

Comments

Reviewer:	Signature:	Date:
Approval *(Name and Title)*:	Signature:	Date:

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DIVISION 15 - MECHANICAL

SECTION 15051

MECHANICAL REQUIREMENTS

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SECTION 15051

MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

This section of the specification covers materials, fabrication, tolerances and finishes, shop testing and inspection and delivery preparation.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

MILITARY SPECIFICATION (MS)

MS MIL-DTL-6070C	(Rev. C) Plywood and Veneer Aircraft Flat Panel

1.3 SUBMITTALS

The Contractor shall submit to the Contracting Officer in accordance with the requirements of Section 01330, "Submittals", the following:

SD-01, Data

Photographic Documentation

SD-07 Schedules

Moisture Meter Calibration Documentation

SD-08 Statements

Quality Assurance Plan
Lumber Drying Facility
Lumber Inspector Qualifications/Certifications
Modal Survey Inspector Qualifications/Certifications
Material and Equipment Substitutions
Project Implementation Plan

SD-09 Reports

Modal Survey Results for Initial Blades
Modal Survey Results for Other 9 Blades
Dimensional Survey of Initial Blade
Dimensional Surveys of Remaining Blades

SD-13 Certificates

Lumber Certification
Polyester Resin
Resorcinol Glue
Fiberglass Cloth
Birch Plywood

SD-18 Records

Order Status Reports
Schedule of Production
Monthly Progress Schedules
Contractor Release Form

PART 2 PRODUCTS

2.1 MATERIAL SPECIFICATIONS

The following list of specifications covers all of the Contractor-furnished materials to be used on the wooden fan blades. The material specifications on the remaining parts are shown on the detail NASA drawings.

2.1.1 Materials

2.1.1.1 Birch Plywood

Military Specification, MS MIL-DTL-6070C, Group I High Density with all plies birch. The specification is obtainable from Naval Air Technical Service, 700 Robbins Avenue, Philadelphia 11, Penn.

2.1.1.2 Fiberglass Cloth

Fiberglass cloth shall be 0.005 inch thick with Volan finish (Clark-Schwebel No. 1522), or equal.

2.1.1.3 Polyester Resin

The resin for the fiberglass cloth shall be isophthalic polyester resin with a minimum service temperature of 180 degrees Fahrenheit.

Resin shall be clear or translucent with no pigment or color additives.

2.1.1.4 Glue

The glue shall be Dap-Weldwood Corporation waterproof, resorcinol glue, or equal.

2.1.1.5 Sitka Spruce Lumber

All Sitka Spruce lumber shall be certified to meet West Coast Lumber Bureau, Standard Number 17, Ladder Rails, grade - VG, or higher. All lumber shall be certified in writing by a Mill Inspector who holds a current American Lumber Society (ALS) approved Grade Agency Certificate.

The Contractor will furnish all the necessary Sitka Spruce lumber. The lumber will be rough sawed, 5/4-inches thick, with minimum width of six (6) inches and maximum width of nine (9) inches, straight random lengths of twelve (12) feet minimum. End butting of any board in any lamination is unacceptable.

Unused Sitka spruce is the property of the Government; boards approximately six (6) feet and longer will be shipped to Langley Research Center as part of the contract.

2.1.2 Glue Mixing Procedure

The glue shall be mixed in strict accordance with the manufacturer's directions furnished with the glue.

Any glue mixed in a given day shall be used that day. Mixed glue shall not be carried over from one day to the next.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Lumber Grading and Selection

The rough lumber to be used in making each lamination shall be dried by the Contractor in a moisture controlled room to a maximum moisture content of seven (7) percent and no less than four (4) percent. In drying the lumber, the maximum temperature shall be 160 degrees Fahrenheit.

Moisture content shall be measured with a commercially available pin or RF type moisture meter. The manufacturer or a commercial calibration service shall have calibrated the meter within one year. A certified verification standard for moisture measurement shall be on hand for field verification of the moisture meter. Each board shall be surveyed for moisture content at a minimum of three locations, near each end and near the board center.

The Contractor shall re-inspect all Sitka Spruce lumber for use on the blades. Certified inspectors shall conduct inspections. Inspectors shall have a current ALS recognized certification to perform lumber grading or American Society for Nondestructive Testing (ASNT)CP-189 Level-II or higher certification to perform visual inspections. Evidence of certification shall be provided upon request.

The lumber selected for the blade lamination shall be vertical grain (from 60 degrees to 90 degrees) free of all defects, knots, pitch pockets, burls, decay, mold, mildew, compression wood, and free from spiral or diagonal grain. The grain of each board in the lamination shall be straight and parallel to the edge of the board.

The lumber shall be pre-inspected in the as-delivered condition to aid in identifying spiral and/or diagonal grain. A Pin-Type slope of grain tool shall be used to increase the fidelity of this inspection. A second inspection shall be performed on each board after the lumber has been

surfaced on both faces.

3.2 BLADE FABRICATION PROCEDURE

The Government may provide a Quality Assurance/Nondestructive Evaluation Inspector at the Contractor's plant during the Blade Fabrication portion of this contract.

3.2.1 Templates, Numbering, and Marking

The Contractor shall make a set of full size male and female station templates of both the flat and contoured side of the initial blade from 1/8-inch thick aluminum mounted on 3/4-inch plywood. Template stations shall be at each radial station along the length of the blade from tip to butt. (See Drawing LD-514650 for radial stations). (These templates shall become the property of the Government and shall be shipped to the Government at the time of the final blade shipment.)

The initial blade shall be stenciled with the number "10" and the remaining blades from "11" - "19". The number shall be three (3) inches in height and clearly labeled on both sides of the blade approximately five (5) feet from the blade tip. Orientation of the numbers shall be with the blade tip at bottom and blade butt at top. All associated documentation for each blade shall be labeled with its respective number.

Upon completion of each blade, the blade shall be weighed and its weight included in the documentation for each blade.

Each blade shall be marked on the butt and tip with vertical and horizontal scribe lines plus any offset reference angles.

The Contractor has the option to create a full size template of each lamination of the blade. Rough-cutting the laminated spruce to the templates reduces the amount of material requiring machining.

All blade bonds shall be free of voids or un-bonded regions that exceed the following criteria:

Butt Region-

1. Single Isolated Defects in excess of 2-inches in any dimension are not allowed.
2. Multiple Isolated Defects, not to exceed six (6) each in any one blade, are allowed provided that they are less than 2-inches in any dimension and are separated by more than 6-inches of defect-free material.

Aerodynamic Blade Region-

1. Single Isolated Defects in excess of 1-inch in any dimension are not allowed.
2. Multiple Isolated Defects, not to exceed six (6) each in any one blade, are allowed provided that they are less than 1-inch in any dimension and are separated by more than 6-inches of defect-free material.

3.2.2 Lamination and Contouring

The Contractor may have to re-saw some of the lumber so that the slope of the grain in any board used in the blade does not exceed one (1) inch in twelve (12) feet. The boards shall then be edge jointed or sawed with a straight-line ripper. In no case shall any two adjacent edges have a gap of more than 1/32 inch prior to gluing. Each board in each lamination shall be at least as long as the lamination; thus, no end butting of the board shall be allowed. The maximum width of board permitted in any lamination shall be nine (9) inches. The boards for each lamination shall then be edge glued and clamped.

After gluing, the lamination shall be put in a moisture-controlled room and dried to seven (7) percent maximum moisture content. This shall be verified by using a certified moisture meter. The lamination shall then be jointed smooth and flat on one side and then planed smooth and flat to a .750-inch thickness. Particular attention shall be paid to General Note Number 4 on NASA Drawing LD-514649, which indicates that the grain of alternate laminations shall run at two (2) degrees thirty (30) minutes, left and right of the reference axis of the blade. At the base of the butt of the blade, the edge-glued joints shall be staggered at least one (1) inch with no set pattern. Each layer of the lamination shall be given an identifying mark to assure that each layer will go into its proper position in the blade.

Before gluing the laminations, a suitable press which is larger than the final blade shall be made. Wood filler blocks, the same thickness as the spruce shall be made so each layer of the lamination together with its filler block is a constant thickness layer that fills the press. Prior to gluing, each lamination and its wood filler block shall be put into the press in their proper order.

After this dry run is made, the individual layers of the lamination, together with their wood filler blocks, shall be set aside in their proper order. The outside edges of the filler blocks shall be waxed to prevent the glue from sticking to the edges. The laminations are then ready for gluing. The inside surface of the first spruce lamination shall be spread with glue, and then both surfaces of the intermediate layers and the inside surface of the top lamination shall be spread with glue. The entire surface of the spruce shall be spread with glue. The top of the press shall be in place and ready for clamping up the entire blade blank within fifteen (15) minutes after the initial glue is spread. The entire gluing operation may be timed by the Government Inspector on the job. Any blade that is not completely glued and ready for clamping in fifteen (15) minutes will be rejected. This requirement is to allow for the proper flow of glue that will ensure minimal bond line thus increasing the blade strength. Clamping pressure must be applied evenly across the surface within the time limits specified by the glue manufacturer. The entire assembly shall remain in the press for sixteen (16) to eighteen (18) hours before the press is removed.

After the blade blank is removed from the press, the excess glue that has squeezed out of the blank shall be removed. Next, the edges of the blade

blank shall be coated with hot wax. The blank shall then be normalized for thirty-six (36) hours.

The blade is then ready for contouring. Before gluing the 1/8-inch birch plywood with resorcinol glue to the flat portion of the butt end of the blade, the butt shall be machined flat.

3.2.3 Finishing

As soon as either the butt section or blade section contour is completed, it shall be primed with a coat of resin, dried thoroughly and sanded smooth before the other section is started.

After the second section is contoured, it shall be coated and treated as above.

Next, a second coat of resin shall be applied to the contoured surface of the blade from its tip end to the start of the butt section. It shall be allowed to set until it becomes tacky; then, one layer of fiberglass shall be applied starting at the trailing edge wrapping around chord-wise of the blade and ending on flat of the trailing edge with a two (2) inch lap joint. The fiberglass shall be rubbed down and the resin allowed to set until it is cured. The width of glass shall run lengthwise of the blade starting at the tip end with a two (2) inch lap.

Next, the glass cloth shall be saturated with resin, the excess resin squeezed out and all entrapped air removed leaving a smooth and fair surface.

Repeat the application of the glass/resin for a second coat of glass applied during this step.

Following the curing of the resin coat, the fiberglass cloth shall be inspected for unsaturated areas, which, if found shall be saturated with resin. This coat of resin may be applied to eliminate any unfilled grain of the fiberglass cloth.

3.2.4 Dimensional Survey

The Contractor shall perform a dimensional survey of each blade.

The dimensional survey shall include, but is not limited to the following requirements.

- o Length of each blade
- o Template fit at each radial station
- o Overall outside dimensions of each blade butt

3.2.5 Ultrasonic Inspection

All blades must successfully pass an air-coupled low-frequency ultrasonic inspection to identify internal voids or un-bond defects. The Government may elect to perform this ultrasonic inspection of the blades after they have been contoured and coated and before final fiberglass wrapping has

been applied. The Contractor shall notify the Contracting Officer ten (10) calendar days before each blade is contoured and coated in order to schedule the Government inspection. The contractor shall provide a safe work location for the inspections and prepare the blades by supporting them flat and horizontally at a waist-high working height.

In the event of a disputed inspection, the Government Inspectors ruling is final.

3.2.6 Modal Survey Requirements

The Contractor shall perform a modal survey of each blade to identify structural resonances between 0 and 150 Hz. The requirements for this test are as follows:

- The blade shall be suspended vertically to simulate a free-free boundary condition. A maximum of a 0.5-inch thru-hole may be located in the blade butt to facilitate suspension of the blade per Sketch No. 1, Modal Survey Setup. Before drilling the 1/2-inch diameter hole, the Contractor shall verify that this location is coincident with the bore hole pattern on drawing number LD-514651, Butt Details.

- The force excitation system shall be sufficient to excite all structural modes in the frequency range of 0 to 150 Hz. However, the excitation system shall cause no damage to the blade structure or the surface finish of the blade.

- A minimum of five accelerometers shall be used to measure the response of the blade. The response accelerometers shall be located at locations and orientations suitable to visually identify the mode shapes of all structural modes from 0 to 150 Hz.

Content and format requirements for the Modal Survey results are listed in Section 01010, "Summary of Work".

3.2.7 Photographic Documentation Record

The Contractor shall provide a photographic record date and time stamped, documenting key phases of the project as follows:

Blade lamination(s)

Completed assembly and setup prior to insertion in the press

Assembly at removal from press

Setup for contouring prior to machining

Any positional changes of blank during the machining process

Completed areas prior to application of resin

Final product

Setup for Modal Survey

The Contractor shall provide an electronic copy of this documentation with Monthly Progress Report to the Contracting Officer. Three (3) hard copy binders of the photographic record shall be submitted prior to contract closeout.

3.2.8 Project Management

The Contractor shall provide the personnel and resources to manage all aspects of the project throughout all phases of work. The Contractor shall submit a Project Implementation Plan for review with its proposal. The Project Implementation Plan shall describe the Contractor's management approach to fulfilling the requirements of this contract, and shall include the following:

- o A complete description of the project scope and content, in sufficient detail, to demonstrate a full understanding of the project requirements.
- o The Contractor's plan and schedule of production for accomplishing the project elements and goals.
- o Quality Assurance Plan

3.2.9 Quality Assurance

The Contractor shall develop and implement a Quality Assurance (QA) program for the lumber inspection and grading, fabrication, dimensional inspection, modal survey, and non-destructive evaluation of the Fan Blades. All Fan Blade components, whether supplied by the Contractor or a subcontractor, shall be fabricated in accordance with an established QA program.

The Contractor is responsible for assuring the quality of its subcontractors' work. The Contractor shall integrate his internal quality assurance activities and those of his subcontractors into an overall approach to best meet the requirements of this Specification.

3.2.9.1 Quality Assurance Plan

The Contractor shall submit a Quality Assurance Plan (QA Plan) as part of the Project Implementation Plan in the proposal. The QA Plan shall include the QA programs of the Contractor and all subcontractors, and shall address the following:

Contractor and subcontractor Quality Assurance personnel, organizations and responsibilities for the project.

Configuration management procedures: The Contractor shall use an established configuration management system to control documentation.

Facility for drying the lumber: The rough lumber to be dried by the Contractor in a moisture-controlled room at the maximum temperature of

160 degrees Fahrenheit.

Equipment calibration processes: The Contractor shall only use calibrated equipment for factory tests. The Contractor shall establish and implement a documented metrology system to control and calibrate measurement equipment and processes in order to provide objective evidence of quality conformance.

A listing of the specific inspections and factory tests to be performed on equipment supplied by the Contractor. This test and inspection list shall be comprehensive of all QA activities on the components including:

Material receipt, certification, storage, and tracking

Fabrication processes

In-process inspections and factory acceptance tests

Handling, packing, and shipping requirements and inspections

Procedures for the disposition of non-conforming equipment

Modal Survey Process, including:

Inspector qualifications and prior experience

Equipment certifications

Test plan

-- End of Section --